



International Civil Aviation Organization

# The FRMS Journey: From Its Beginnings to ICAO's Standards

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# Today's FRMS Topics

- The Beginnings
- Why Introduce FRMS?
- ICAO's Approach
- What It Is, and What It Isn't

# NASA Ames & Pan Am Bombay, 1982



# NASA In-Flight Crew Fatigue Studies 1981-89

CAUSE OF FATIGUE HAZARD	DOMESTIC SHORT HAUL	DOMESTIC NIGHT CARGO	LONG HAUL
Restricted sleep due to short rest breaks	X		
Restricted sleep due to early duty report times	X		
Multiple high workload periods across the duty day	X		
Multiple sectors	X	X	
High density airspace	X		
Long duty days	X		X
Extended wakefulness on duty days			X
High workload during circadian low		X	X
Shorter sleep periods at wrong phase in the circadian cycle		X	X
Circadian disruption (due to night work)		X	X
Split sleep patterns and short sleep episodes on layovers		X	X
Circadian disruption (due to crossing multiple time zones)			X
Circadian drift (changes in circadian cycle) following extended trip patterns			X

# The International Team Approach

## Industry, Regulators, Labor, & Science (1985)



*NASA Ames*  
*RAF IAM*  
*Farnborough*  
*DFVLR*  
*Stanford*  
*Univ.*  
*Jikei Univ.*  
*USN Hlth*  
*Rsch Ctr*



*British Airways*  
*Lufthansa*  
*Pan Am*  
*Japan Airlines*  
*BALPA*  
*ALPA*  
*Vereinigung*  
*Cockpit*  
*UK CAA*

# International Layover Sleep Study

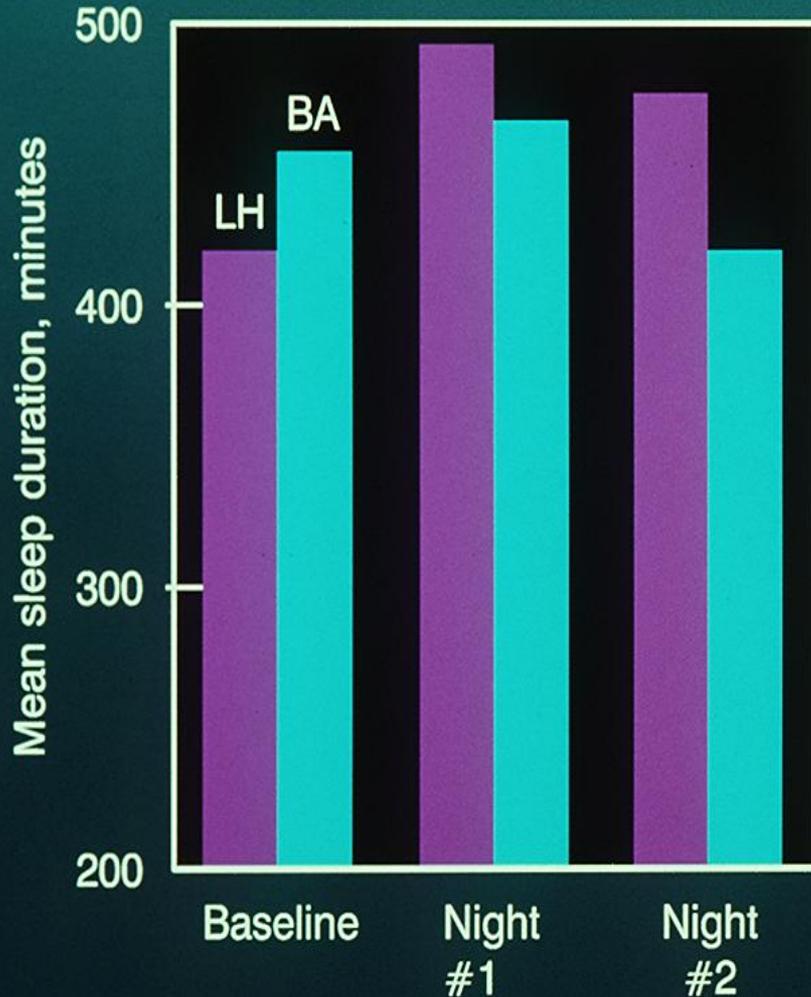


# International Layover Sleep Study

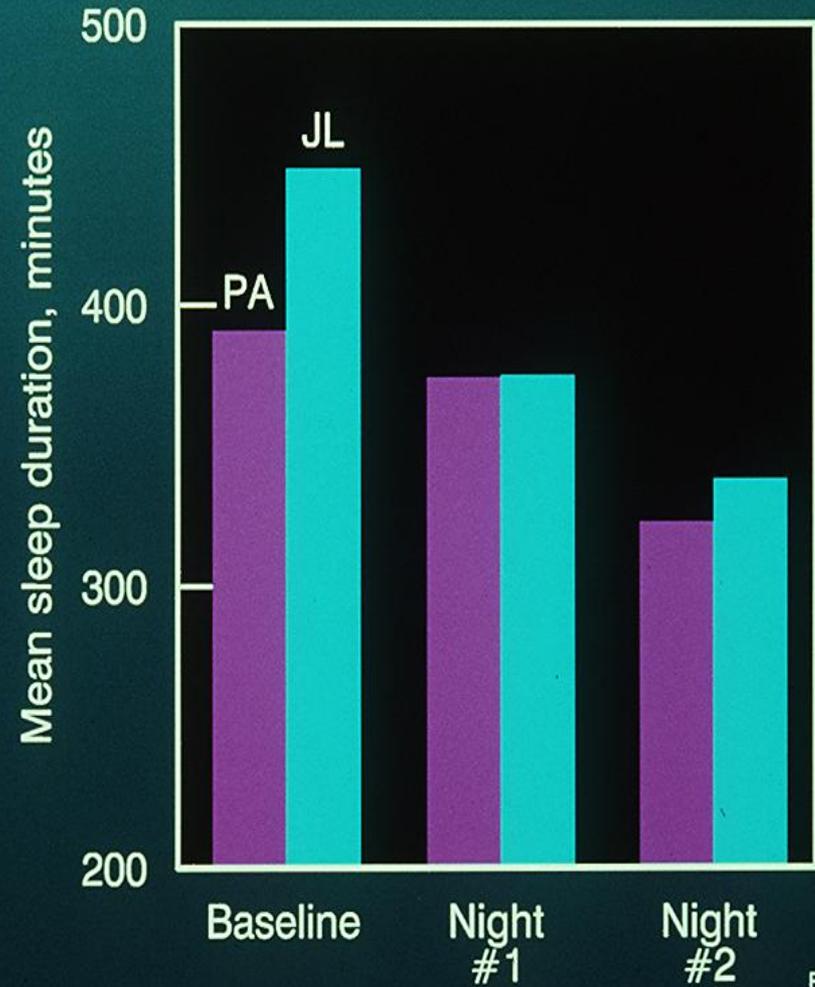
## Nocturnal Sleep Depends on Flight Direction



### Westward



### Eastward

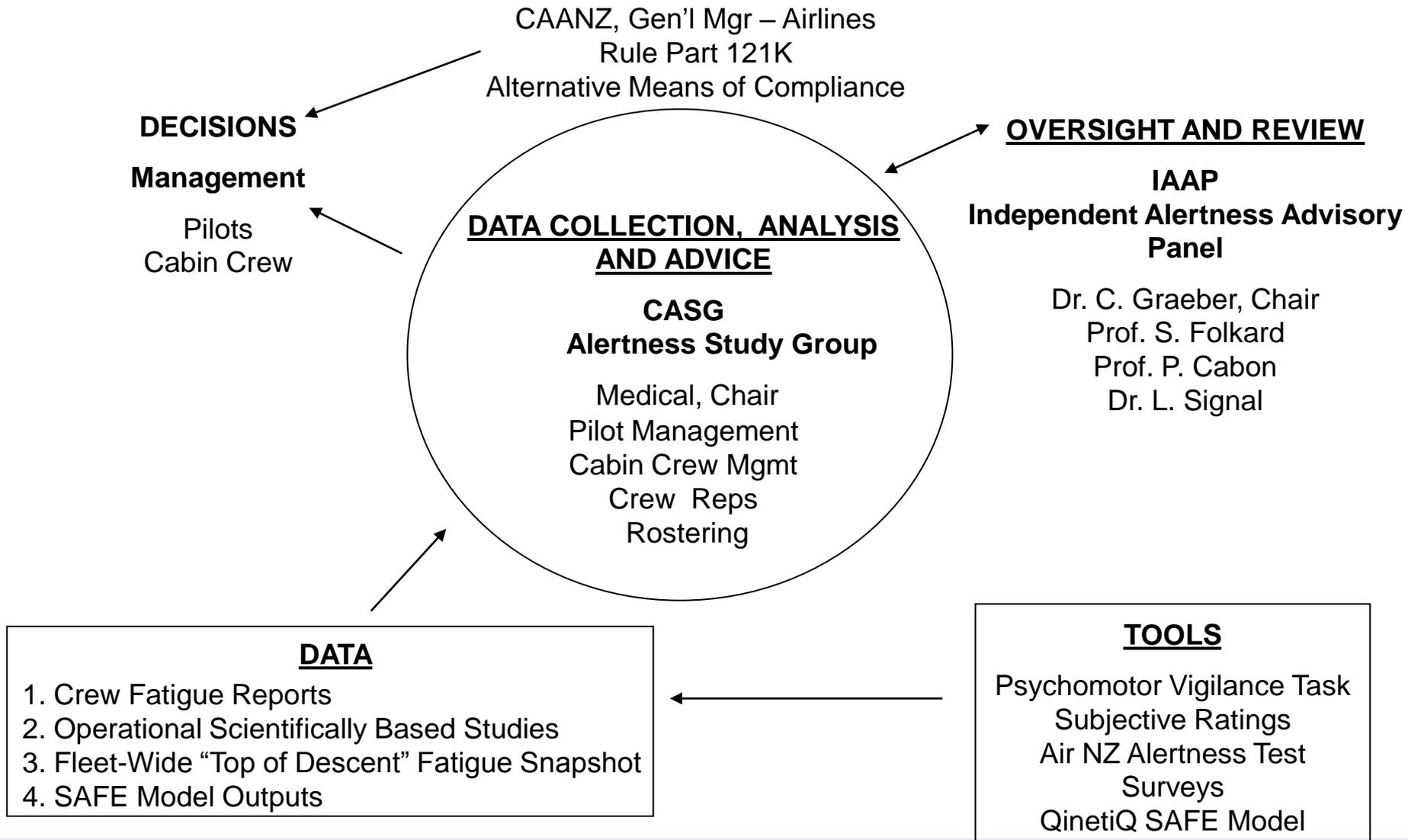


# So What Came of it?



- 1993: Air New Zealand seeks an innovative, data driven approach for crew scheduling.
- Teams with NASA, NZ and UK scientists to develop.
- Forms an internal multi-disciplinary team to implement.
- Establishes external oversight panel.

# AIR NEW ZEALAND'S FATIGUE RISK MANAGEMENT SCHEME





# Managing Fatigue Risk in ULR

Ultra Long-Range: An operation involving any sector between a specific city pair (A-B-A) in which the planned flight time exceeds 16 hrs.

- Get ahead of the challenge
- Leverage industry and scientific knowledge
- FSF can facilitate a comprehensive global approach
- No formal tie to regulatory authorities
- Steering Committee of key stakeholders

# Ultra-Long Range Crew Alertness Steering Committee



## Airlines

Air New Zealand

Singapore Airlines (AAPA)

British Airways (AEA)

Delta Airlines (ATA)

## Regulatory Authorities

JAA (UK CAA)

Ex-CASA

## Flight Safety Foundation\*

## Professional Associations

IFALPA

## Science - Medical

QinetiQ

Sleep-Wake Research Centre

## Manufacturers

Boeing\*

Airbus

\* co-chairs



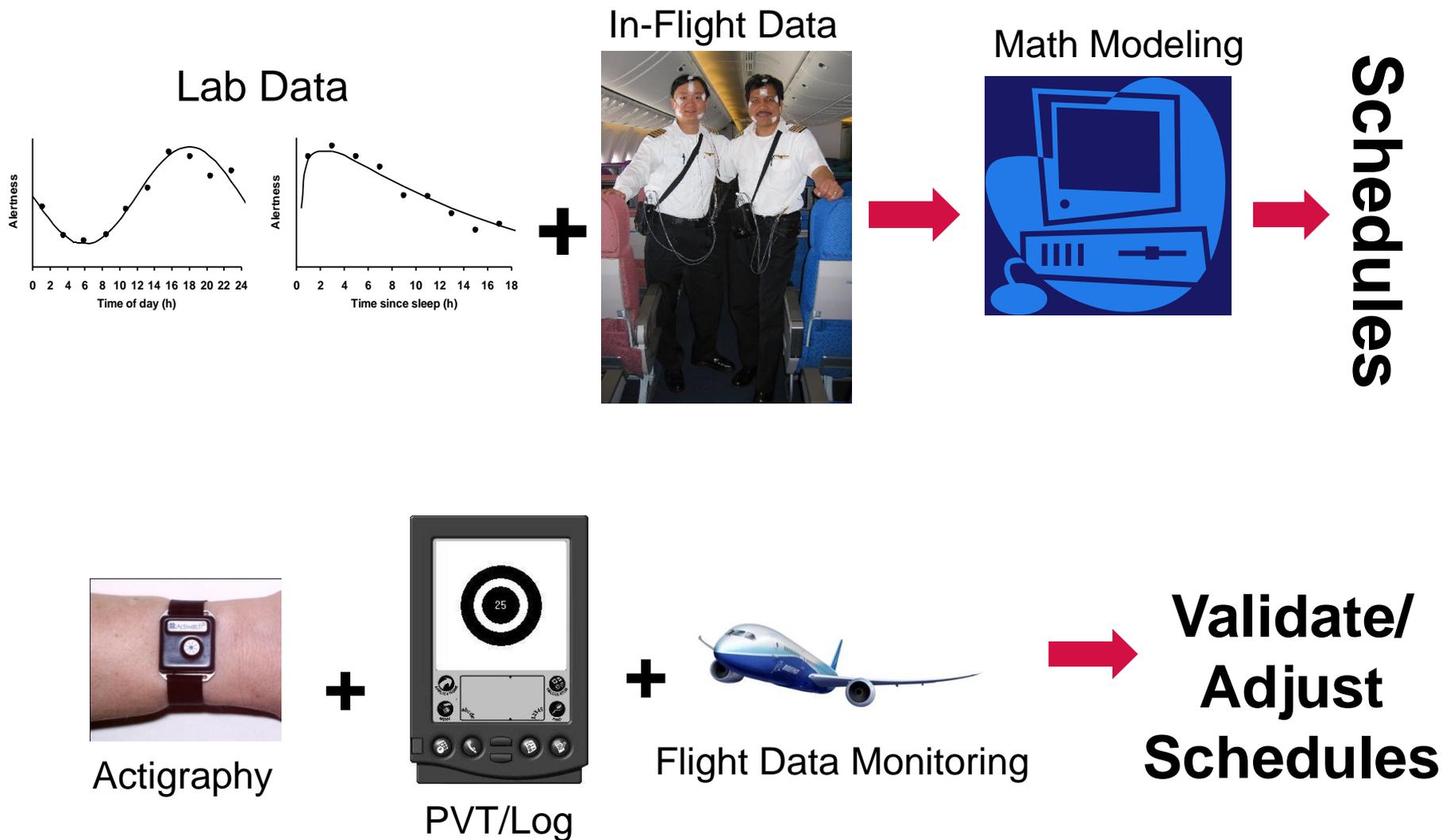
# ULR Crew Alertness Workshops



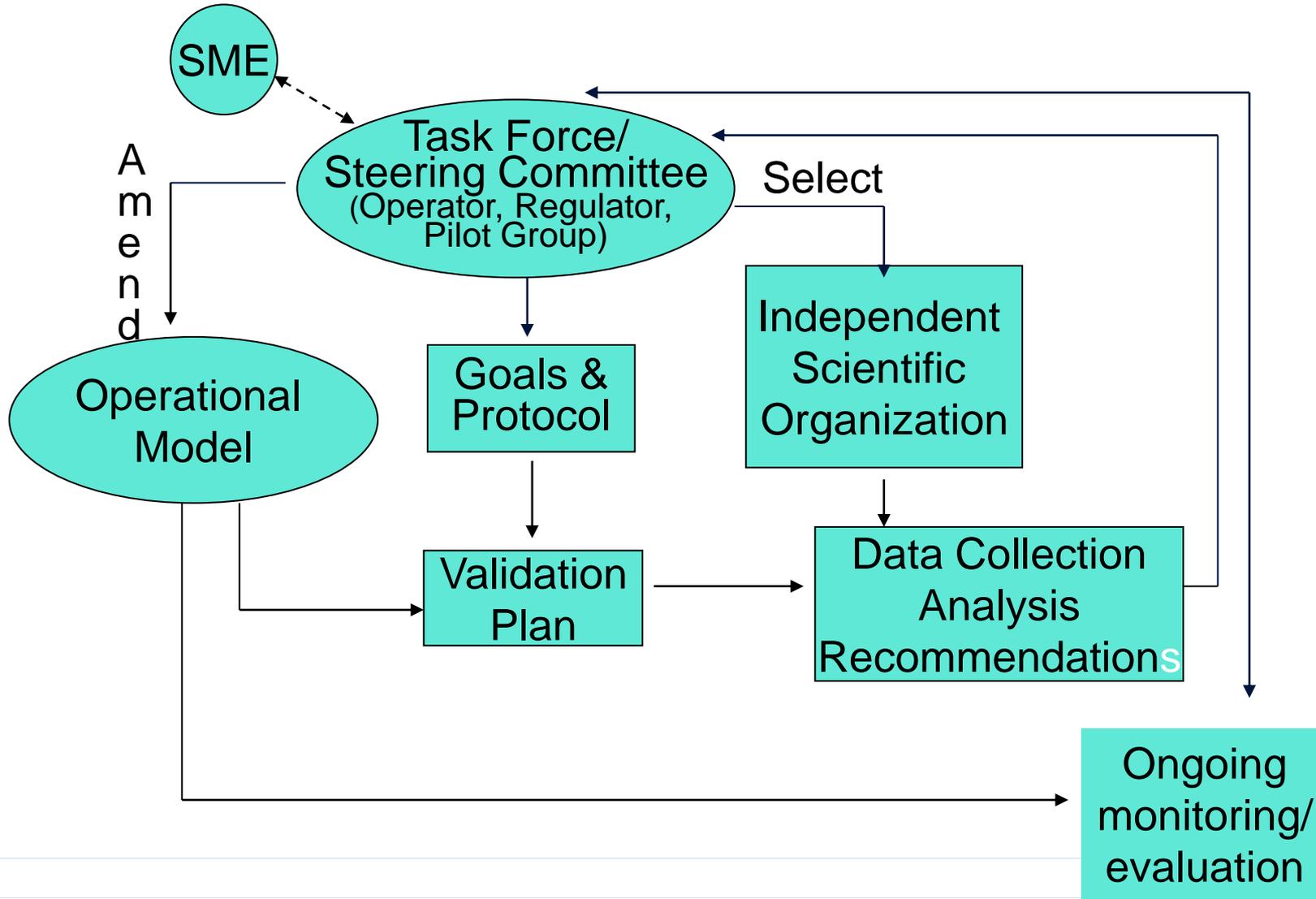
Washington, DC (Boeing): June 12-14, 2001  
Paris, France (Airbus): March 4-7, 2002  
Kuala Lumpur (AAPA): March 12-14, 2003  
Los Angeles (SQ follow-up): May 24-26, 2005

- Determine common approaches
- Develop technical basis for operational and regulatory guidance
- Seek global multi-stakeholder consensus
- 90 participants from 14 countries

# Enabling ULR Operations



# Validation Process for Operational Model



# Today's FRMS Topics



- The Beginnings
- **Why Introduce FRMS?**
- ICAO's Approach
- What It Is, and What It Isn't



## ICAO Annex 6 Part I Flight & Cabin Crew

- Prescriptive flight and duty time limitations
  - Revised 2009
  - Parameters based on scientific principles
  - Specifics identified by regulator
  - One-size fits all
  - Arbitrary “safety” line
- Covered in 4 chapters, not integrated

# Do Flight Duty Limitations (FDLs) Work?



- Fatigue related accidents and incidents continue.
- Unable to address key alertness factors.
- Limits identified by industrial agreements.
- Unsuccessful attempts to set new limits.
- Exemptions are extremely common.
- No worldwide standards to enable fair competition.
- Over 25 years of scientific results awaiting application.

# What is FRMS?

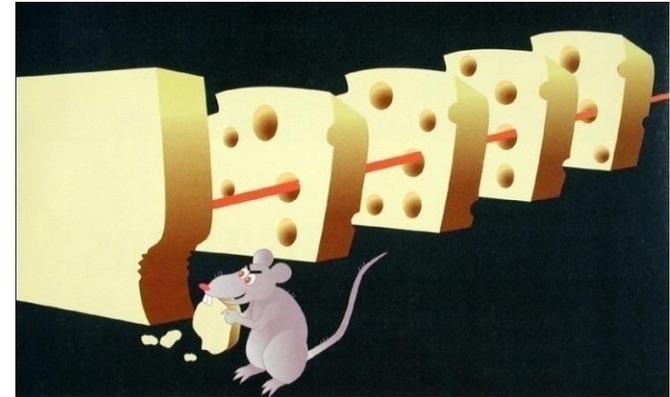


A data driven means of continuously monitoring and managing fatigue-related safety risks that aims to ensure crew members are performing at adequate levels of alertness.

- Addresses fatigue irrespective of the cause.
- Based upon scientific principles and knowledge as well as operational experience.
- Requires a systematic, organizational approach.
- Includes flight and cabin crew.
- Requires shared responsibility among management and crews.

# Why move to FRMS?

- Prescribed limitations provide only “one slice of cheese”.
- FRMS provides more defence barriers.
  - Addresses alertness variables not addressed by FDLs.
  - Reflects unique and changing airline factors.
  - Manages fatigue risk relevant to specific circumstances
- Allows for greater operational flexibility.
- Can result in potential insurance reductions.



# Today's FRMS Topics



- The Beginnings
- Why Introduce FRMS?
- **ICAO's Approach**
- What It Is vs. What It Isn't

# How did ICAO develop the FRMS SARPs proposal?



- Previous work by ICAO Ops Panel:
  - FTL Subgroup (2003-06)
  - FRMS Subgroup (2006-08)
  - FRMS Subgroup proposes introduction of FRMS to Annex 6 in a Working Paper (2008)
- FRMS Task Force (2009-11)

# FRMS Task Force – Members and Advisors



States	Organisations	*Operators	Scientists
Australia	EASA	Delta Airlines	Prof. Philippa Gander (NZ)
Canada	IATA	Emirates Airlines	Prof. Philippe Cabon (FR)
China	AEA	Etihad Airways	Prof. Greg Belenky (US)
France	ICCAIA - *Boeing	Qantas	ICAO: <i>Dr. Curt Graeber (Leader)</i> <i>Dr. Michelle Millar (Technical Coordinator)</i>
Germany	*Airbus	easyJet	
Japan	IFALPA	Air New Zealand	
New Zealand		DHL	
Singapore		Singapore Airlines	
United Arab Emirates		Lufthansa	
United Kingdom			
United States			

\* Advisors to member States or organizations.



# What was ICAO trying to achieve?

Provide standards and guidance which:

- Improve the ability to manage fatigue risk
- Apply current scientific knowledge and tools plus industry best practice
- Are based on joint industry-government consensus
- Identify various operationally viable methods
- Assure appropriate regulatory oversight
- Enhance global harmonization in their use

# The Task



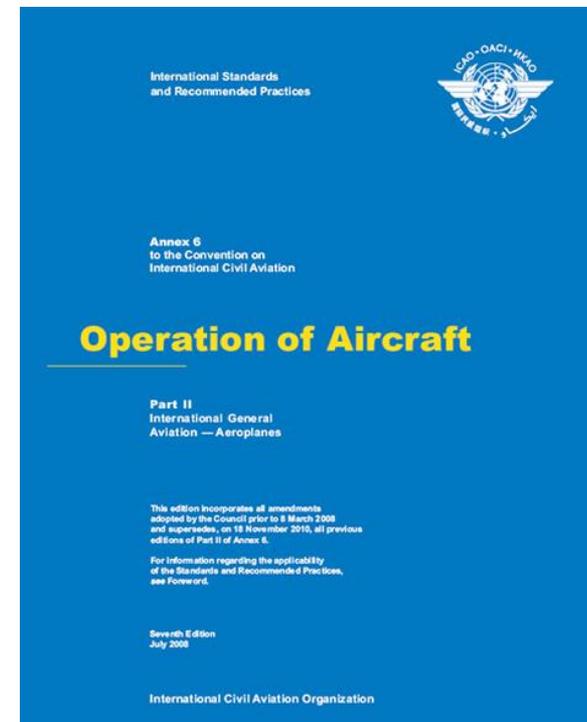
- Build upon the Ops Panel's previous work.
- Specify the implementation of a non-prescriptive approach.
- For application to:
  - Annex 6, Part 1 Operators: International Commercial Air Transport – Aeroplanes
  - Flight crew and cabin crew
- Provide guidance so that States can oversee, and operators can use, FRMS.

# The Outcome

Combined all fatigue management standards into one section in Chapter 4:

- Prescriptive Flight & Duty time limitations
- FRMS

Developed detailed FRMS guidance material.





# Today's FRMS Topics

- The Beginnings
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# Key Concepts

1. Crew Fatigue Safeguards
2. Operational Flexibility
3. Labor agreements
4. Impact on Personnel
5. Scientific basis
6. Data driven
7. Vulnerability to manipulation
8. Continuous improvement
9. Relationship to SMS
10. Regulatory Oversight

# Key Concepts

## Crew Fatigue Safeguards

- ~~FRMS reduces safety by eliminating flight duty time limits that assure crews fly rested.~~
  - ~~Must ask crews: “Are you legal?”~~
- It improves safety by addressing factors that prescriptive limits don't address.
  - Must ask crews: “Are you too tired to fly?”
- Enables management of fatigue risk irrespective of the cause.
- Enables operators to mitigate fatigue risk in a measureable way.

# Key Concepts

## Operational Flexibility

- ~~FRMS is primarily designed to increase operational flexibility at the expense of fatigued crews.~~
- ~~It allows operators to fly whenever they want.~~
- It improves flexibility by focusing on those specific operational factors that cause fatigue and mitigating their impact on crews.
- Enables operators to improve efficiency without jeopardizing safety due to fatigue.

# Key Concepts

## Labor Agreements

- ~~• FRMS enables operators to bypass the work hour provisions of labor agreements designed to protect crew from fatigue.~~
- It accommodates labor agreements in a manner that improves crew's protection from fatigue inducing rosters and schedules.

# Key Concepts

## Impact on Personnel

- ~~• ICAO's FRMS only affects flight and cabin crew.~~
- It affects all personnel and managers involved in rostering, route design, training, safety systems, and crew well being.
- It assures awareness of fatigue risks at all levels of the organization.
- FRMS approach is broadly applicable to other safety related personnel.

# Key Concepts

## Scientific Basis

- ~~• It is a new unproven scientific concept which does not consider operational factors and which requires complicated scientific procedures.~~
- FRMS was developed from over 30 years of research and 18 years of successful application at major airlines around the world.
- Integrates scientifically based fatigue risk assessment into operational planning.

# Key Concepts

## Data Driven

- ~~• FRMS consists of applying biomathematical models of fatigue to analyze flight schedules and rosters.~~
- ~~• Objective FDM data is sufficient; no subjective data is required from crew members.~~
- Biomathematical models can be used to initially assess the fatigue risk of particular schedules but are not sufficient.
- Model outputs must be validated.
- Both objective and subjective data, including fatigue reports, are essential for any FRMS.

# Key Concepts

## Vulnerability to Manipulation

- ~~• The FRMS data can be falsely manipulated by crew members who seek to portray a particular operation or duty roster as too fatiguing.~~
- ~~• Operators are at the mercy of “outlier” crew members.~~
- Standard statistical techniques can be used to identify data that originate from artificially manipulated inputs.
- Such data can be legitimately discarded.

# Key Concepts

## Continuous Improvement

- ~~• Once implemented, FRMS goes on autopilot.~~
- ~~• Once a schedule or roster is positively assessed by FRMS, no further data or analysis is required.~~
- FRMS is based on a continuous improvement process.
- While the need for in-depth data analysis may diminish following an initial positive analysis, continued oversight based on data is required.

# Key Concepts

## Relationship to SMS

- ~~• FRMS is separate from an operator's other safety reporting systems.~~
- FRMS is based on continuous improvement, just like SMS.
- Depends on an effective safety reporting culture and active involvement of all stakeholders.
- Requires the routine acquisition and analysis of safety reports.
- ICAO recommends FRMS be integrated with SMS.

# Key Concepts

## Regulatory Oversight

- ~~• FRMS is too complicated to enable sufficient regulatory oversight.~~
- FRMS is based on well defined processes and data analysis.
- ICAO has developed guidance for regulators for overseeing FRMS.
- Regulators will find that oversight of FRMS is similar to that of SMS.

# Conclusion

- FRMS offers a better way to manage fatigue risk than only operating within duty hour limits.
- FRMS applies scientific knowledge within a comprehensive, accountable approach.
- FRMS represents a paradigm shift in managing fatigue as a safety risk.
- FRMS offers a major opportunity to improve aviation safety worldwide.

# Contact Details



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